

# ADVANCED MATERIALS ENGINEERING (MATE)

## Advanced Materials Engineering (MATE) Courses

### **MATE 5103. Principles of Materials Engineering: Fundamentals of Structure, Chemistry, and Physical Properties. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. Overviews of the fundamental underpinnings of structure-property relations of materials, which determines their behavior at the macro-, micro-, nano-, molecular- and atomic-levels, as used in passive and active components and systems for applications such as sensing, actuation, energy conversion and storage. This course has Differential Tuition.

### **MATE 5113. Functions, Evaluations and Synthesis Technology of Advanced Materials. (3-0) 3 Credit Hours.**

Prerequisite: MATE 5103 or consent of instructor. Introduction to state-of-the-art materials processing, properties evaluation, and performance optimization of semiconductor, electroceramics, composites, nanomaterials, and thin films. This course has Differential Tuition.

### **MATE 5213. Sensing and Sensor Materials. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. Fundamentals of design, fabrication, and evaluation of advanced sensing materials and modern sensor technology. This course has Differential Tuition.

### **MATE 5223. Structure-Chemistry-Property Relations in Materials Science and Engineering. (2-3) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. Principles that govern assembly of crystal structures, building models of many of the technologically important crystal structures, and discussion of the impact of structure on the various fundamental mechanisms responsible for important and unique physical properties. Theory and principles are introduced along with hands-on experience of building structure models. Major topics include: Symmetry and Crystal Physics; Density, Mechanical Strength, and Anisotropy; Electronic Transport in Materials; and Thermal Properties. This course has Differential Tuition.

### **MATE 5233. Anisotropy and Crystalline Materials. (2-3) 3 Credit Hours.**

Prerequisite: MATE 5103 or consent of instructor. Symmetry operations through coordinate transformation matrices and stereographic projections. Tensor operations applied to anisotropic crystals, polar and axial symmetries. Principle and design of sensor applications including pyroelectricity, pyromagnetism, thermal expansion, dielectric constant, magnetic susceptibility, piezoelectricity, piezomagnetism, electrostriction, magnetostriction, index of refraction, and nonlinear optical effects. Mathematica is used to model and analyze a variety of tensor properties. This course has Differential Tuition.

### **MATE 5243. Optic and Nonlinear Optical Materials. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. Mechanisms of polarization nonlinearity, electromagnetic wave propagation in optical and nonlinear optic materials, optoelectronic materials and their device applications. This course has Differential Tuition.

### **MATE 5253. Magnetic Materials and Electromagnetic Engineering. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. Fundamental understanding of material responses to applied electromagnetic fields, correlated with time inversion symmetry, material chemistry, crystal structure, and microstructure for controlling and engineering electronic and magnetic properties. This course has Differential Tuition.

### **MATE 5393. Topics in Advanced Materials Engineering. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. Topics to be selected on the structure and properties, preparation and processing, characterization and performance evaluation of materials, computational modeling and simulation, with emphasis on ceramics, electronic materials, engineered composites for sensor, actuator, energy conversion and storage, or biomedical applications. May be repeated for credit as topics vary for a given concentration. This course has Differential Tuition. Course Fee: LRE1 \$25; STSE \$30.

### **MATE 5493. Topics in Materials Engineering and Application. (2-3) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. Topic 1: Advanced technology in materials/devices fabrication and property evaluation Topic 2: Micro- and nano-structure imaging and characterization Topic 3: Thermodynamic phenomenological modeling of crystalline system, computational materials simulation and finite element Multiphysics analysis Topic 4: Critical analysis of current development and literature in relevant materials research subject. Concentration I aims at sensor, actuator, energy conversion and storage applications, while Concentration II aims at biocompatible materials and biomedical applications. Instructor may specify which concentration a given topic serves in a given semester or the course serves both concentrations. May be repeated for credit as topics vary. This course has Differential Tuition.

### **MATE 5513. Fundamentals of Microfabrication and Application. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. This course describes the science of miniaturization which is essential for nanotechnology development. Microfabrication techniques for micro-electro-mechanical systems (MEMS), bioMEMS, microfluidics, and nanomaterials and their applications in biomedical research will be covered. This course has Differential Tuition. Course Fee: LRE1 \$25; STSE \$30.

### **MATE 5523. Biosensors: Fundamentals and Applications. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. This course will cover biosensing basics and in-depth view of device design and performance analysis. Topics include optical, electrochemical, acoustic, piezoelectric, and nano-biosensors. Emphasized applications in biomedical, environmental, and homeland security areas are discussed. This course has Differential Tuition.

### **MATE 5543. Current Analytical Tools for Biomaterials Characterizations. (3-0) 3 Credit Hours.**

Prerequisite: Graduate standing or consent of instructor. This course introduces the fundamentals of biomaterials characterizations and its limitations. May be repeated for credit when topics vary. This course has Differential Tuition.

### **MATE 6941. Master's Project. (0-0) 1 Credit Hour.**

Prerequisite: Consent of the Graduate Advisor of Record and Project Advisor. Conducted under the guidance of the Supervising Professor and the advice of the Master's Nonthesis Committee. The nonthesis project will be an independent investigation or research in the chosen concentration and is generally completed in one semester. Additionally, the nonthesis investigation will be documented, evaluated by the Master's Nonthesis Committee, and placed in the student's record indicating successful completion of the project. May be repeated for credit, but not more than 3 hours will apply to the Master's degree. This course has Differential Tuition.

**MATE 6942. Master's Project. (0-0) 2 Credit Hours.**

Prerequisite: Consent of the Graduate Advisor of Record and Project Advisor. Conducted under the guidance of the Supervising Professor and the advice of the Master's Nonthesis Committee. The nonthesis project will be an independent investigation or research in the chosen concentration and is generally completed in one semester. Additionally, the nonthesis investigation will be documented, evaluated by the Master's Nonthesis Committee, and placed in the student's record indicating successful completion of the project. May be repeated for credit, but not more than 3 hours will apply to the Master's degree. This course has Differential Tuition.

**MATE 6943. Master's Project. (0-0) 3 Credit Hours.**

Prerequisite: Consent of the Graduate Advisor of Record and Project Advisor. Conducted under the guidance of the Supervising Professor and the advice of the Master's Nonthesis Committee. The nonthesis project will be an independent investigation or research in the chosen concentration and is generally completed in one semester. Additionally, the nonthesis investigation will be documented, evaluated by the Master's Nonthesis Committee, and placed in the student's record indicating successful completion of the project. May be repeated for credit, but not more than 3 hours will apply to the Master's degree. This course has Differential Tuition.

**MATE 6951. Directed Research in Advanced Materials Engineering. (0-0) 1 Credit Hour.**

Prerequisite: Graduate standing and permission in writing of the instructor and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours will apply to the Master's degree. This course has Differential Tuition.

**MATE 6952. Directed Research in Advanced Materials Engineering. (0-0) 2 Credit Hours.**

Prerequisite: Graduate standing and permission in writing of the instructor and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours will apply to the Master's degree. This course has Differential Tuition.

**MATE 6953. Directed Research in Advanced Materials Engineering. (0-0) 3 Credit Hours.**

Prerequisite: Graduate standing and permission in writing of the instructor and the Graduate Advisor of Record. Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work not normally or not often available as part of the regular course offerings. May be repeated for credit, but not more than 3 hours will apply to the Master's degree. This course has Differential Tuition.

**MATE 6961. Comprehensive Examination. (0-0) 1 Credit Hour.**

Prerequisite: Consent of the Graduate Advisor of Record. Independent study course for the purpose of taking the Comprehensive Examination. May be repeated for credit as many times as approved by the Graduate Studies Committee. Enrollment is required each term in which the Comprehensive Examination is taken if no other courses are being taken that term. The grade report for the course is either "CR" (satisfactory performance on the Comprehensive Examination) or "NC" (unsatisfactory performance on the Comprehensive Examination). This course has Differential Tuition.

**MATE 6981. Master's Thesis Research. (0-0) 1 Credit Hour.**

Prerequisite: Consent of the Graduate Advisor of Record and Thesis Advisor. Thesis research and preparation conducted under the guidance of the Supervising Professor and the advice of the Master's Thesis Committee. The thesis is an original contribution to scholarship, based on intense independent investigation or graduate research in the chosen concentration. Thesis option students are required to successfully present and defend their thesis, which serves as the oral comprehensive examination for the thesis option. Final approval of the thesis by the Graduate School will serve as an indication of the successful completion of the research. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. This course has Differential Tuition.

**MATE 6982. Master's Thesis Research. (0-0) 2 Credit Hours.**

Prerequisite: Consent of the Graduate Advisor of Record and Thesis Advisor. Thesis research and preparation conducted under the guidance of the Supervising Professor and the advice of the Master's Thesis Committee. The thesis is an original contribution to scholarship, based on intense independent investigation or graduate research in the chosen concentration. Thesis option students are required to successfully present and defend their thesis, which serves as the oral comprehensive examination for the thesis option. Final approval of the thesis by the Graduate School will serve as an indication of the successful completion of the research. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. This course has Differential Tuition.

**MATE 6983. Master's Thesis Research. (0-0) 3 Credit Hours.**

Prerequisite: Consent of the Graduate Advisor of Record and Thesis Advisor. Thesis research and preparation conducted under the guidance of the Supervising Professor and the advice of the Master's Thesis Committee. The thesis is an original contribution to scholarship, based on intense independent investigation or graduate research in the chosen concentration. Thesis option students are required to successfully present and defend their thesis, which serves as the oral comprehensive examination for the thesis option. Final approval of the thesis by the Graduate School will serve as an indication of the successful completion of the research. May be repeated for credit, but not more than 6 hours will apply to the Master's degree. Credit will be awarded upon completion of the thesis. Enrollment is required each term in which the thesis is in progress. This course has Differential Tuition.